RAILWAY ENGINEERING
and Maintenance of Way

PUBLISHED BY THE
BRUCE V. CRANDALL COMPANY, CHICAGO

Office of Publication, Rooms 409-410 Security Building, Cor. Madison St. and Fifth Ave., Chicago

TELEPHONE MAIN 3185.

Eastern Office: Room 714, 132 Nassau Street, New York City
TELEPHONE 3524 John.

Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, bridges and buildings.
Communications on any topic suitable to our columns are solicited.
Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 10 cents. Advertising rates given on application to the office, by mail or in person.
In remitting make all checks payable to the Bruce V. Crandall Company.
Papers should reach subscribers by the twentieth of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Vol. 1. CHICAGO, JULY, 1905. No. 4.

Effect of Oil on Concrete

THE alarm raised with reference to the disintegration of concrete when subject to the action of oleaginous compounds is a case parallel with that of of the steel coal car in which corrosion hastened the failure of a construction thought to be invulnerable to the chemical action of acids liberated by the load. A remedy for corrosion of steel was found in certain pigments, and one will also no doubt, be found for the destructive effect of oil on concrete. It is only two years since positive knowledge obout this was obtained, and then the discovery was largely accidental, although there had been some discussion on the effect of oil on concrete construction prior to 1903. Notwithstanding this the negative side of this question has not a few adherents who cite innumerable cases where concrete has been exposed to the action of oil without any sign of deterioration whatever.

Experiment, however, has demonstrated that oil does have an appreciable effect on the integrity of concrete. There is no doubt that the element of age has more to do with the power of concrete to resist oil penetration than any other one factor, this being shown by the ability of older construction to remain practically unharmed under all circumstances, while the greatest penetration and evil effects are noted in comparatively recent work, and this has also been especially seen in new briquettes experimented on, which showed the most rapid disintegration. The kind of oil in contact with concrete is no doubt the most active harmful factor in its weakening effects, lard oil and signal oil both being very penetrating, and disintegration is said to be certain when concrete is of such a quality as to give a low resistance to penetration, or for want of time to harden. While definite information is wanting as to the actual effect of different oils under all conditions and kinds of concrete construction, engineers are alert to grasp any new developments on the subject as they arise.

The data thus far gathered by means of laboratory experiments alone furnish but meager facts on which to predicate action, and may be responsible for the variance of opinion among engineers on this subject, there is, however, no doubt that a certain set of conditions is conducive to the failure of concrete when exposed to the action of oils or grease, and it is the province of those interested to determine just what these conditions are. It is certain that only positive knowledge should be allowable with a concrete construction that supports loads, even though flooring like that in oil houses may not succumb to the effects of oil; the fact that disintegration takes place under any combination of circumstances should be sufficient warning to the maintenance of way engineer, and in taking proper heed of same it would appear to be a wise thing to investigate the value of any composition that will act as a preventive to penetration.

Points on Permanent Way

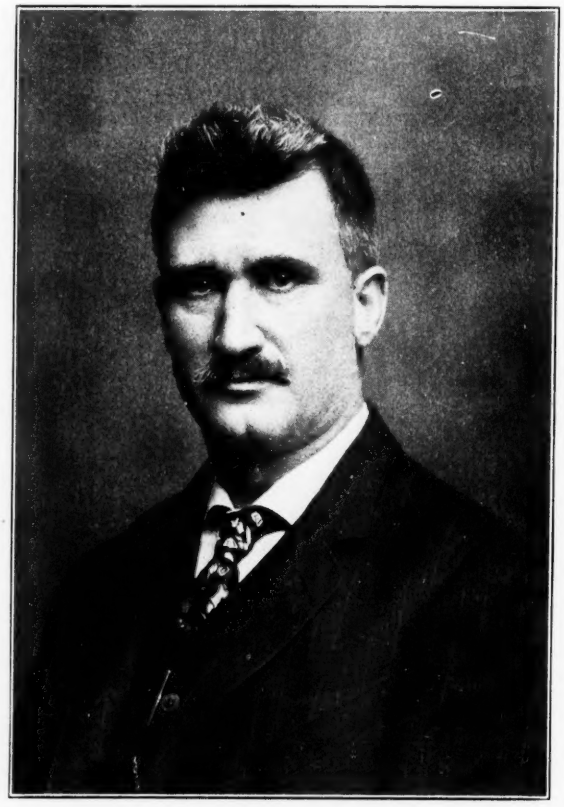
THAT the American and European engineers are not so far apart in maintenance of way practice, is seen in the general uniformity of views held by them on the more important details of their work. A few points will serve to show briefly their respective positions in attaining results. In this country the alternating joint is used to a somewhat limited extent, with a growing opinion in favor of it; the Paris, Lyons & Mediterranean Ry., however, had not found their use satisfactory after a long trial and returned to the even joint system. On Belgian railways, the alternating joints are used only on heavy grades, it having been observed that rail creeping was less with that type of joint. In the matter of tie spacing, there are fewer ties per mile on European roads than is the practice in America, and the ties are set closer together near the rail joints, in the former practice, to insure smooth riding, but the alternating of joints interferes with such tie spacing.

There seems to be little said by the American engineer in favor of unusually long rails, on account of their higher price and the difficulties attending their straightening, transportation and installation. The Paris, Lyons & Mediterranean Ry., however, has 186 miles of road equipped with rails 59 feet long, besides which there are some nearly 79 feet in length. It has been found in France that the breaking of long rails is a rare occurrence, and that their removal and replacing does not pre-

sent especial difficulties. The tendency of English roads has been toward longer rails, the increase having extended from 33 feet, the old standard, to 45 feet, and in some cases to 60 feet in length. The consensus of foreign opinion seems to crystallize on the use of long rails, 59 feet being a length now quite usual in Europe. In America the standard length is 33 feet. It is not looked upon with favor abroad to weld joints, in order to attain the long rail.

Creeping rails have been found most difficult to handle on American roads, and the problem has produced many devices looking to prevention of this evil. A German scheme to remedy longitudinal creeping, is to fasten the rails to as many intermediate ties as may be necessary to accomplish the object sought.

A French method is to introduce stop plates to the middle of the rails by means of a bolt passing through the rail web and fixed to the tie by means of three lag screws. This process is said to effectually prevent creeping. This idea has also been worked out in America in some instances, with marked success, and justifies the belief of the engineers who have used it that a preventive for creeping rails has been found.



MR. JAMES E. HURLEY,
GENERAL MANAGER, ATCHISON, TOPEKA & SANTA FE.

Mr. Hurley was born at Wapello, Iowa, on June 1st, 1860, and after finishing high school at that place spent three winters at the Normal school in Bloomfield, Iowa. He entered the service of the Santa Fe in 1880 as brakeman and was subsequently until 1882 warehouse man and baggageman. He was then for one year telegraph operator and station clerk at various stations in Kansas and during 1883 was relief agent on the Rio Grande and Mexico Division and chief clerk and cashier at Hutchinson, Kansas. Since then he has held consecutively the following positions: Agent of Florence, Kansas, Chief Clerk to the General Supt., at Topeka, Train Master Eastern Division, Ass't Supt. Missouri Division, Ass't Supt. Chicago Division in charge of transportation at Fort Madison, Iowa, from October 1891 to June, 1894; Supt. New Mexico Division June, 1894, to October, 1894; Supt. Consolidated New Mexico and Rio Grande Division October, 1894, to January, 1901; Acting General Supt. lines west of Albuquerque at Los Angeles, Cal., January to October, 1901. On the latter date he was appointed Gen. Supt. of the Western Grand Division at La Junta, Colorado, and in July, 1902, was made Gen. Supt. of the Eastern Grand Division, which position he held until May 1st, 1905, when he was appointed General Manager.

Wooden Crossties

SOME valuable information on selection, preservation and care of wooden ties, was brought out in the proceedings of the International Railway Congress at Washington, and receiving the endorsement of that body is spread on the minutes as a part of their official conclusions. As to the selecton of material, either hard or soft woods may be used. The choice of same depending on local conditions. Pickling of ties was generally recommended because of its effect in giving a longer lease of life to ties thus treated, but the selection of the antiseptic, and the method of performing the pickling operations, depend on individual conditions. Creosote seems to be the best preservative of ties, it having been successfully tried for a longer time than any other antiseptic, and the results have proved that a creosoted tie will last in main line service many times as long as one untreated.

With reference to specifications, they must be exact, and great care should be exercised by the inspector before accepting ties for treatment. When accepted the ties should be piled at least six inches above the ground, in open stacks, and in such a manner as to allow free access of air and light. The grounds surrounding the piles of ties should be kept clean and free from decaying matter. When the tie is laid, the uncovering of it by removing the ballast from the top surface does not appear to diminish the life of the wood, even when untreated timber is used, and it has the advantage of enabling the track inspector to discover at once any defects in the track fastenings, and to apply a remedy. In some special cases, and especially in warm countries, it may be useful to cover the tie with ballast.

It is of importance to combine rigid inspection in accepting ties, with great care in the selection of ballast; the latter must be permeable and must be capable of being well maintained, and give good adhesion between the tie and its seat. As far as this is concerned, the measures which are best for the preservation of the wood, are also best for the stiffness of the track. In order to prevent deterioration of the ballast, and at the same time help to preserve the ties, the careful drainage of the roadbed cannot be too strongly insisted upon in order to insure that water may run off properly.

To prevent mechanical wear of the rails upon the ties, it is of the greatest importance to fasten the rail to the tie in such a manner as to prevent as much as possible all vertical, lateral and horizontal movement between the two. The old American method of using only spikes,

will not accomplish this. Lag screws seem to be necessary to attain satisfactory results.

It is only by keeping careful and accurate records of the number of ties treated, and the manner in which they were treated, and where and when they were placed in the track, together with a record of when they were taken out of the track, that it is possible to determine whether any one particular treatment is giving satisfaction, and is a good investment. Every railroad management using treated ties is urged to have them all marked, with dating nails, and that a careful system of records should be instituted at the earliest possible time.

That portion of the subject having a bearing on the causes of deterioration of wooden ties in tropical climates was not reported on, for the reason that the data collected on the question was not sufficient, or of a character to permit the drawing of accurate conclusions, a fact, however, that does not seriously detract from the foregoing, since causes operating to that end in the United States are fairly well understood.

The Preservation of Timber with Antiseptics

By E. H. Bowser, Member Louisiana Engineering Society, Published by the Journal of the Association of Engineering Societies

WHILE there are facts indicating that efforts were made to prolong the life of the timber used in structural work, by means of antiseptics, as early as 400 B. C., still, so far as we know, no very satisfactory results were obtained until the decade between 1830 and 1840. Many of the processes which came into use at that time, though somewhat effective, have practically been abandoned.

The only preservatives that have stood the test of time and that are used to any great extent at present are chloride of zinc and dead oil of coal tar, the latter commonly called creosote oil, though it contains no true creosote.

The chloride of zinc treatment is not nearly so common in this country as creosoting, and it is used almost solely for the preservation of cross ties. This treatment is not very effective, except when the timber is kept comparatively dry, as the chloride is very soluble in water. It is of no value whatsoever for the protection of timber or piles against marine worms.

This chloride was first brought into extensive use by Sir William Burnett in 1838, and it has from that time until the present been more or less used. On account of the man who promoted its use, the process is known as Burnettizing. Ordinarily, the solution for this process is composed of 2½ per cent of zinc chloride and 97½ per cent of water. One of the principal recommendations for the use of this process is its cheapness.

The zinc solution is often combined with other substances with the object of preventing the chloride from being affected by moisture. In the Wellhouse process the chloride is mixed with the usual amount of water and creosote oil is added to this mixture. In the Allerdyce process the timber is first treated with the chloride of zinc solution and then, after letting it dry for a few days, or, without taking the Burnettized timber from the cylinder, it is treated with about 3 lbs. of creosote oil. The theory is that the outer pores of the wood are filled with the creosote oil and this keeps the moisture from coming in contact with the chloride.

Another method of zinc treatment which is used to a considerable extent by the Mexican Central Railroad at Aguas Calientes, in Mexico, is the zinc-tannin-glue process. The timber is first treated with the chloride of zinc, the liquid is then drawn off, and a weak solution of glue is run into the cylinder; when this is drawn off a solution of tannin is put in. The theory of this process is that the glue gets into the outer portion of the wood, and the tannin hardens the glue, making it insoluble in water.

The bichloride of mercury, also called corrosive sublimate and sulphate of zinc were formerly used for preserving wood, but the former is used very seldom, and the latter probably not at all. The worst feature of any of the metallic salts that have been used for preservative purposes is their solubility in water, which decreases their effectiveness very much when the treated timber is buried in damp ground or exposed to the action of the weather. Of course, none of these salts are at all effective when the timber is placed directly in the water.

The first authentic record we have of the use of creosote oil for the impregnation of timber in order to preserve it from decay is in 1756, though the value of rosin, tar and pitch was know in ancient times.

It was not, however, until ohn Bethell, of England, invented the process of injecting oils or other liquids into timber that creosoting was placed upon a practical basis. From that time until the present, the creosoting process has been constantly gaining favor and is universally recognized as being by far the best process for the preservation of timber, in the earth, in the water, or in the air, and it is the only process that is effective against the destruction of timber by the Teredo navalis, or other marine worms, and insects. For the benefit of some of you who may never have visited a creosoting plant, I will explain the present method of creosoting, as done in this country, and give an idea of the appliances used.

For simplicity, we will take a one-cylinder plant. A common size of cylinder is 6 ft. diameter and 100 ft. long. There are, however, several cylinders in this country 9 ft. in diameter, and one of these, located in New

Orleans, is 173 ft. long, and, I think, is the largest creosoting cylinder in the world. A 6-ft. cylinder should be made of flange steel five-eighths of an inch thick, with horizontal seams triple riveted, and girth seams double riveted. The lengths of the rings are usually 6 ft., one sheet of metal making the entire ring. The cylinder is mounted upon supports about 2 ft. above the floor so as to allow for pipe connections underneath. The ends are sealed by hinged doors, generally made by riveting hemispherical boiler-plate heads on cast flanges, though probably a better door is made of cast steel slightly convexed and ribbed. The doors for a 6-ft. cylinder are fastened by 36 bolts 2 in. in diameter. There is a circular ridge on the face of the door flange 2 in. wide and ¼ in. high, which fits into a corresponding groove, on the face of the cylinder flange, three-eighths of an inch in depth. Cotton or asbestos webbing is placed in the groove so that when the door is closed and bolted it is steam tight.

In the bottom of the cylinder is a track upon which the trucks loaded with timber are run. Between the rails of this track are from 12 to 18 1-in. steam pipes, extending from one end of the cylinder to the other. Often there are steam pipes on the sides just below the center of the cylinder. These pipes are connected at the ends with rturn bends and coupled to a steam pipe from the boiler. The heating pipes should be divided into three or four disconnected groups, causing less condensation of steam than would occur through a long series of pipes and allowing any one or two of the groups to be cut off should a break occur during the process of treatment.

For supplying steam to the cylinder there is a 2-in. pipe steam or oil is on, by the leakage of the steam or oil through the open end of the pipe. When steam is passed through the coils for heating timber during the vacuum or heating the oil when it is in the cylinder, the coils should be open at the exit end during the vacuum and open or slightly throttled during the injection of oil.

Connected with the cylinder from the bottom, generally near the middle, there should be a 6-in. suction pipe leading to the vacuum pump.

At the top of the cylinder there should be a 3-in. pipe which leads to the discharge end of the oil pump, the suction end of this pump being connected by a 4-in. pipe with the measuring tank.

Between the measuring tank and the cylinder there should be a 10-in. pipe connection and also the same size pipe between the cylinder and the underground or dumping tank. These pipes can be connected just before entering the cylinder to save an extra opening.

For supplying steam to the cylinder there ise a 2in pipe which is coupled at the shell of the cylinder to a 1-in. pipe which lies along the heating pipe coils, the 1-in. pipe being perforated with small holes throughout its length to dissipate the steam when it is turned into the cylinder upon the timber. The heating coils are also attached to the 2-in. pipe.

Finally, there is a vertical pipe of from 4 to 6 in. in diameter leading from the top of the cylinder through the roof. This is a blow-off pipe for letting out the steam after the timber has been steamed sufficiently. All of the pipes are, of course, supplied with the proper cut-off and check valves.

Upon the bulkheads at the ends of the cylinders are laid tracks upon which the trucks are loaded. At one end of the cylinder the untreated timber is loaded on the trucks and at the other end it is unloaded after it is treated. The side where the timber is loaded is usually called the "white side" and where it is unloaded, the "black side."

The measuring tank is usually about 20 ft. in diameter and from 20 to 25 ft. high, and rests on a tank frame 12 to 14 ft. above the ground. The oil in the measuring tank is kept hot by means of 1-in. steam pipe coils inside of the tank. These pipes are hung vertically in pairs coupled at the bottom with return bends and hanging at intervals of about 5 ft. The tank is supplied with a float and gage so that the depth of oil in tank is always shown.

The underground or dumping tank is usually of the same capacity as the cylinder. It should be buried deeply enough in the ground to be covered with sufficient earth to prevent it from floating up when empty, if there is water in the ground. The dumping tank and other storage tanks used should have heating coils, as in cool weather more than 50 per cent of creosote oil, containing the amount of napthalene ordinarily specified in contracts, is more or less solid.

A pump is needed between the dumping tank and the measuring tank so that the oil can be returned to the latter tank after a treatment is made. In a two-cylinder plant this pump should be of large capacity to prevent delay.

Oil received in tank cars or barrels can be dumped directly into the underground tank and then transferred by means of the pump into the measuring tank or storage tanks. There should be a derrick or traveling crane at each end of the works for loading and unloading the trucks.

The most economical handling of the material is, of course, where it can be unloaded directly from cars to the trucks and after treatment unloaded from the trucks and put directly on cars for shipment.

For pulling the train of loaded trucks into and out of the cylinder a hoisting engine is used, with proper ropes, cables and blocks.

The complete process of treatment used almost universally in this country at the present time is as follows:

The timber is loaded on the trucks and drawn into the cylinder by means of a wire cable which is fastened to the rear end of the load, and passes under the trucks, and around the sheaves at the end of the unloading track to blocks and tackle, the fall line of which is fixed to the drum of the hoisting engine. The cable has a coupling near the front end of the load and the part lying under the load is left in the cylinder. As soon as the doors are closed and bolted, the steam is turned into the cylinder

and kept there under the required pressure for from ten to eighteen hours, according to the amount of oil required.

The treatment under consideration is supposed to be of freshly sawed timber and not seasoned at all. Seasoned timber requires no steaming.

The steam is turned off at the proper time and the condensed water in the bottom of the cylinder is blown out before the steam is exhausted through the pipe at the top.

When the steam is all out the vacuum pump is started and kept going for from five to eight hours, the vacuum being brought as quickly as possible to a gage reading of from 22 to 24 in. During this process steam is passed through the heating coils.

When the vacuum pump is stopped the oil, heated as hot as it can be gotten by steam pipe coils containing steam under little or no pressure, is admitted into the cylinder and as soon as it is full a reading of the tank gage is taken, and the pressure pump is started. When the pressure gage registers about 150 lbs. the pump is generally held at that until the timber has received, according to the gage, the proper amount of oil. The oil is then dumped into the underground tank and pumped back into the measuring tank. The difference in the reading of the tank gage before the oil is put into the cylinder and after it is pumped back into the measuring tank, gives the exact amount of oil injected into the timber, the pores of the wood beng under a vacuum, some treatment is completed, as during the filling of the cylinder, all pores of he wood being under a vacuum, some oil is absorbed and, of course, the amount of this absorption is not shown on the gage readings between the filling of the cylinder and the completion of the treatment. This absorption will sometimes amount to as much as 2 or 3 lbs. per cu. ft.

The theory of this process is that the steam opens the pores of the wood and liquefies the sap. The heat in the coils during the vacuum vaporizes the moisture in the wood and this vapor is taken off by the vacuum pump. The vacuum being in the wood when the oil is admitted draws more or less oil into the pores and the pressure from the pump forces in the remainder of the oil required. If dry heat could be used in the heating coils and in the cylinder, and the treatment by that method would require no longer time, it would be a vast improvement over the present method. The great trouble would be in obtaining the heated air as cheaply and in regulatng the temperature as exactly as can be done with steam.

Timber can be injured by being subjected to too high a temperature in steaming. I would recommend the following steam gage pressure for steaming timber and piles:

Least dimension 3 in. or less	30 lbs.
Least dimension 6 in. to 8 in.	35 lbs.
Least dimension 8 in. and more	40 lbs.
Piles for teredo water	50 lbs.

I do not think that the temperature due to these pressures, when applied for the length of time usually employed in creosoting, will injure the timber in the least. For teredo water I think the steam pressure shown for piles in teredo water is better than a lower temperature.

While the treatment of timber with creosote oil has been widely practiced for more than sixty years, no absolutely definite decision has been reached as to the best kind of oil to be used for this purpose. Creosote oils differ considerably in their constituent parts, and it has never been fully decided what proportion of these constituents the best oil should have. Until recently -the greater number of experts on creosoting have considered that naphthalene was the most important constituent in the oil, and nearly all of the specifications in this country stated that there should not be less than 40 per cent. of naphthalene in the oil. Lately, however, many of them are advocating a preponderance of the heavy oils beyond naphthalene in the distillation, and consider the latter substance of no importance whatsoever. This is largely due to the fact that naphthalene, though insoluble in water, vaporized at all temperatures, and it is claimed by parties who have made tests with specimens of treated timber that in time all of it passes from the wood. Whether this is correct or not, the experience of the Louisville & Nashville Railroad Company shows that oil with a large amount of naphthalene in it is good oil for the preservation of timber both from decay and from the teredo, when the material is well treated. I am, however, of the opinion that the heavy oils are preferable to the naphthalene, though I do not think it has been proven belond a doubt. The great trouble is that it takes thirty years to properly test a preservative. Outside of its use in creosote oil, about the only commercial value of naphthalene is for manufacturing moth balls, and as the manufacturers of creosote oil naturally wish to get rid of their naphthalene, and moth balls give them a very small market, possibly this fact has had considerable influence in making it prominent as the principal preservative in the oil.

I have received oil from the foreign market that had as much as 75 per cent. of naphthalene, and it was solid in the barrels in warm weather. It was impossible to give good treatment with this oil, as it could not be gotten thin enough with steam heat to penetrate the wood, and it had to be mixed with lighter oil before it could be used.

The ordinary analysis of creosote oil is by simple distillation, it being necessary to use reagents only when the amount of tar acids in the oil is to be determined. To make this distillation, an ordinary 200-gm. glass retort is used and the heat applied by a Bunsen burner or a special laboratory lamp where gas cannot be obtained. The products of distillation are collected in the test tubes in the usual way and the percentages determined by weight. One distillation is all that is required, but a second distillation will, of course, give more refined results. I give below the products that come off at different temperatures, a centigrade thermometer being used:

Up to 170 deg. water, hydrocarbons and phenols	liquid
170 to 205 deg. phenols anl creosols	solid and liquid
205 to 210 deg. phenols, creosols and naphthalene	solid
210 to 235 deg. naphthalene, chiefly	solid
235 to 240 deg. naphthalene and anthracene	solid
240 to 270 deg. anthracene oil	liquid
270 to 316 deg. anthracene oil and anthracene	solid and liquid
316 deg. plus pitch	solid

An analysis of oil from the Barrett Manufacturing Company, made in 1899, is as follows:

85 to 170 deg.	1.4
170 to 205 deg.	7.7
205 to 210 deg.	7.3
210 to 235 deg.	53.8
235 to 240 deg.	5.0
240 to 270 deg.	9.4
270 to 316 deg.	3.5
316 deg. plus	11.3
Loss	.6
	100.0

This oil at the time it was used was considered to be fine oil for creosoting purposes. With the large amount of naphthalene in this it would require all of the light liquids shown to make it thin enough to enter the wood. It would, however, have been a better oil if it had a little less light liquid, less naphthalene and more heavy oil beyond 260 deg. Here is an analysis of a sample of Scotch oil made the first part of this year:

Up to 170 deg.	7.48
170 to 205 deg.	9.91
205 to 245 deg.	44.03
245 to 270 deg.	14.03
270 to 320 deg.	12.36
320 to 420 deg.	3.80
Residue	8.39
	100.00

Specific gravity, 1.028 at 40 deg. C. Tar acids by volume, 12.25 per cent. According to the old standard for oil in this country there is too much distillate up to 205 deg. and too little between 205 deg. and 245 deg. The remainder of the distillate would have been very satisfactory, as there is somewhat more than 25 per cent. above 260 deg.

The lack of naphthalene and too much light liquid gives a low specific gravity. If the distillation shows the oil to be good the specific gravity will always be right. Taking into consideration its preservative qualities and also the extra expense of using an oil that differs very much from the natural product of the works from which creosote oil is obtained, I would recommend the following specifications for oil:

"Water to the extent of 2½ per cent. shall be allowed in the oil without compensation. Any amount of water over 2½ per cent. and up to 8 per cent. shall be compensated for by the injection of a proportionately greater quantity into the timber. No oil containing more than 8 per cent. of water shall be used. The specific gravity shall not be less than 1.04 at a temperature of 35 deg. C. It must not yield more than 10 per cent. of its weight by distillation up to 210 deg. C. Between 210 deg. C. and 235 deg. C. the distillate shall not exceed 30 per cent. by weight, nor shall be less than 25 per cent. At least 30 per cent. shall not distill until after 260 deg. C. has been reached. The thermometer is to be kept about one-eighth of an inch from the oil during distillation."

I am sure these specifications would give an oil that would be satisfactory for all purposes and would last either in teredo water or in any other situation.

Any wide departure from the natural by-product of the distillers, of the residual liquids from gas works and coke retorts, would increase the expense of the oil very materially by the extra manipulation and the reduction of the natural output by the wasting of some of the con-

The supply of creosote oil does not always equal the demand. Four years ago the chief engineer of the Louisville & Nashville Railroad was paying as high as 12½ cents a gallon for oil and could not get it as fast as needed. The price just previous to that time was six cents per gallon. If all the creosoting works had been in full operation this year the available supply would have been exhausted by the middle of the year if it had been evenly distributed. At the first of this year, just before the railroads began to cut down expenses on account of lack of traffic, there was only 300,000 gals. offered in this country for delivery during this year, and practically none was for sale in England, where nearly all of the foreign oil in this country is purchased.

The distillation of slack coal from the mines is becoming an industry in this country, but it is receiving somewhat of a check from the fact that some of the ore-smelting operators claim that the coke obtained is not so good for their purpose as that made in open coke ovens. Without the sale of the coke, the distillation of coal for other products would be unprofitable.

As to the lasting qualities of creosoted timber, every engineer knows that it has been fully demonstrated.

Some very fine specimens of creosoted work can be found on the line of the Louisville & Nashville Railroad, between Scranton and New Orleans. Large numbers of piles in the bridge piers on this line are in teredo water, have been there more than 28 years, and are still in a perfect state of preservation. Many of these piles are in places where they would be unsafe in three months if put in the water at the beginning of the teredo season. Recently in rebuilding these bridges it became necessary to cut off a few feet from the ends of the piles to get them low enough for the new superstructure, and nearly all of them were in as good condition as the day they were driven. The few that had been affected had been

broken or split by collision from boats, or by coming in contact with floating timber or drift wood during storms.

In the Louisville & Nashville Railroad wharves in Pensacola Bay there are a great many creosoted piles driven 23 years ago which are still in use and in good condition.

About as satisfactory a record as I know of, is that of a long line of telegraph poles in England which were treated with only 8 lbs. of oil per cu. ft., and from a thorough examination, after they had been in use for 30 years, not a single one of them was found to be affected by decay. These poles were naturally seasoned before treatment. This, no doubt, gave slightly better results than steaming would have done. Ordinarily 12 lbs. of oil per cu. ft. are used for telegraph poles, though sometimes only 10 lbs. are used.

At West Pascagoula, Miss., before the burning of the creosoting works last year, there was a telegraph pole treated in 1877 which was in a perfect state of preservation. Unfortunately, it was burned down to the ground at the time of the fire. I judged from the appearances that this pole was treated with more oil than is generally used for this class of work.

In this section pine is the only wood used for creosoting, and, with the exception of the lower grades of oak for cross ties, pine is used universally in all parts of the United States for this purpose.

I give below a schedule showing the proper amount of oil per cu. ft. to be put into timber used for different purposes:

Foundation timbers and lower floor joists for buildings, fence posts and cross ties.....	10 lbs.
Bridge, wharf and culvert timbers natural and sawed telegraph poles, cross-arms and wooden ducts for electric wires.....	12 lbs.
Piles for interior work.....	16 lbs.
Sawed timber for teredo water.....	18 lbs.
Paving blocks	20 lbs.
Piles for teredo water, as much as can be put into the timber, in no case less than.....	22 lbs.

There is not the least doubt that well-creosoted timber will last considerably longer than 30 years, and I venture to say that a heavily treated sap-wood pole would last at least 60 years, and, possibly 100 years, if not destroyed by other agents than decay. An untreated sap pole would begin to decay at the ground in about six months, and would generally be rotted through and through in two years.

It must be borne constantly in mind, however, that to be thoroughly effective, creosoting must be well done. This is an all-important point about creosoting work, and it is a thing that can be very easily slighted by the carelessness of an inspector, or the careless or culpability of the operators of a creosoting plant.

Parties having creosoting work done must depend more or less upon the honesty of the contractors doing the work, even if there are a dozen inspectors employed who thoroughly understand the process of treatment. No one knows exactly what is going on in the cylinder, no matter how closely he watches it. Sometimes accidents will occur that will cause bad treatment without the operator finding it out.

I have the record of one load which turned out bad, while I was superintendent at the West Pascagoula Works. This was sheathing for a dredge boat. In one year the teredos completely riddled about two-thirds of this sheathing. Either through the careless of the engineer in charge at the time, or through some accident, the proper amount of oil did not get into the lumber, but I could not trace the cause. Of course, such occurrences as these are comparatively rare. Unless work is intentionally slighted for profit, it can be done properly by any one who understands the work, but it requires very close and constant attention to details.

Good oil in one treatment may be bad oil in a succeeding one. For instance, the breaking of one of the pipe coils in the measuring or the underground tank may, in a very short time, put a great deal more water into the oil than good treatment will allow. To get the best results a test should be made for water before every treatment, and the sample should be taken from the pipe through which the cylinder is filled and drawn continuously during the filling. Occasionally a sample should be taken from the discharge pipe of the oil pump when the oil has nearly all been injected in the timber. In the measuring tank most of the water is in the upper portion of the oil, but it would hardly be fair to test an average sample from the measuring tank, as the oil is drawn from the bottom of the tank, and if the measuring tank has two cylinder loads in it, the upper half of the oil will contain a very much larger proportion of water than the lower half.

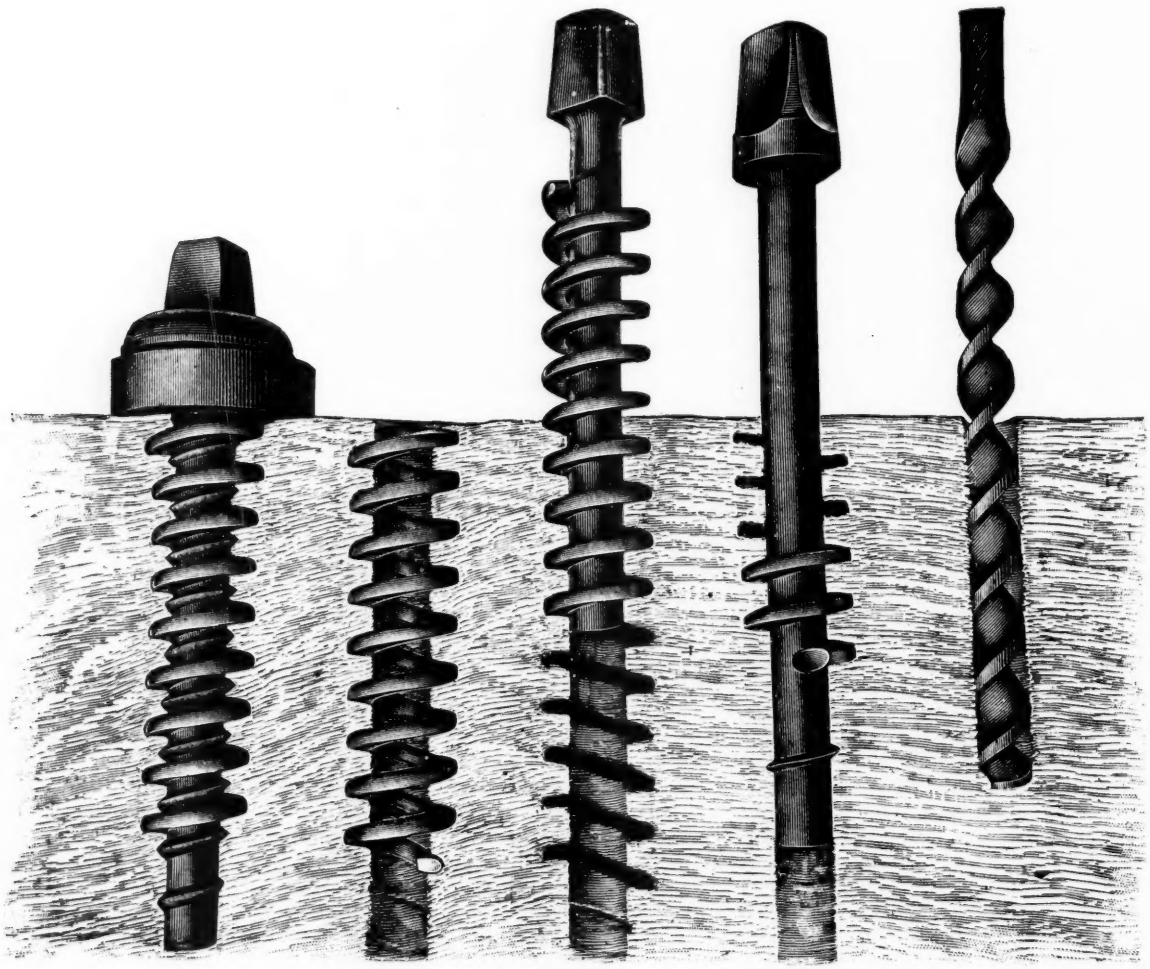
At the first creosoting works of which I took charge, I found there was too much water in the oil, and, after investigation, found that no steam came from the exit of the steam coils in the measuring tank, the throttle being nearly wide open at the other end where the steam entered. This, of course, meant a broken pipe. All of the steam that went into the oil was condensed.

At another works I found 30 per cent. of water in the oil, and pumped out about 10,000 gals. of water on the ground. This water contained about 10 per cent. of oil. At one time during my management I failed, for a short period, to personally analyze the oil being used, and an inspector making an analysis found 17 per cent. of water in one of the tanks from which we were using oil. There was not, however, a large quantity affected. I mention these incidents to show how easiy it is to get water in oil, even when it is not the intention of the operator to let water accumulate. The most difficult feature in operating works of this kind is to keep the water out of the oil, and any one who can invent a suitable process that will do away with the direct use of steam in the cylinder and coils, will do a great work in the advancement of the preservation of timber by means of creosote oil.

Thiollier's Helical Rail Fastening

THERE is no other device connected with the security of the T-rail and as old in point of service as the ordinary track spike which depends for its permanancy, on its frictional resistance in the tie, ond there is also no other means for accomplishing this result that will give a higher efficiency when first applied, but when the spike becomes loosened by the terrific impact of traffic, and the question of maintenance presses for recognition, then the need of a fastening that will retain its integrity becomes of first importance. Resistance to displacement is the thing to be provided, and in either hard or soft ties this has always been a condition too ephomeral to appear to the heads of maintenance of way departments, when the spike is depended on.

A fastening known as the Thiollier helical lining, carrying the name of its inventor, M. Thiollier, has been installed on most of the European railways, with most satisfactory results. As its name implies, it is a screw fastening which has a feature of construction that while having the advantage of the screw, has the additional advantage of a nut to receive the screw, in the form of a steel helix having the appearance of a spring, and of the same pitch as the screw. To introduce this helical lining into the tie, the latter is tapped with a specially devised tool, having a thread corresponding in pitch and form, to that on the helical coil, and the latter is then screwed to place, forming the nut for the track screw. One of the important advantages connected with the use of this fastening, is that due to the action of the screw in the lining, which is always under sufficient compression as to prevent backing out. The permanence and stability of this device, now in service on more than thirty prominent railways abroad, has proven it a popular one, for the reason that a rail cannot become displaced, and for the further reason that the screw may be withdrawn and applied an indefinite number of times without impairing its holding power. These facts should be potent enough to force its use in this country.

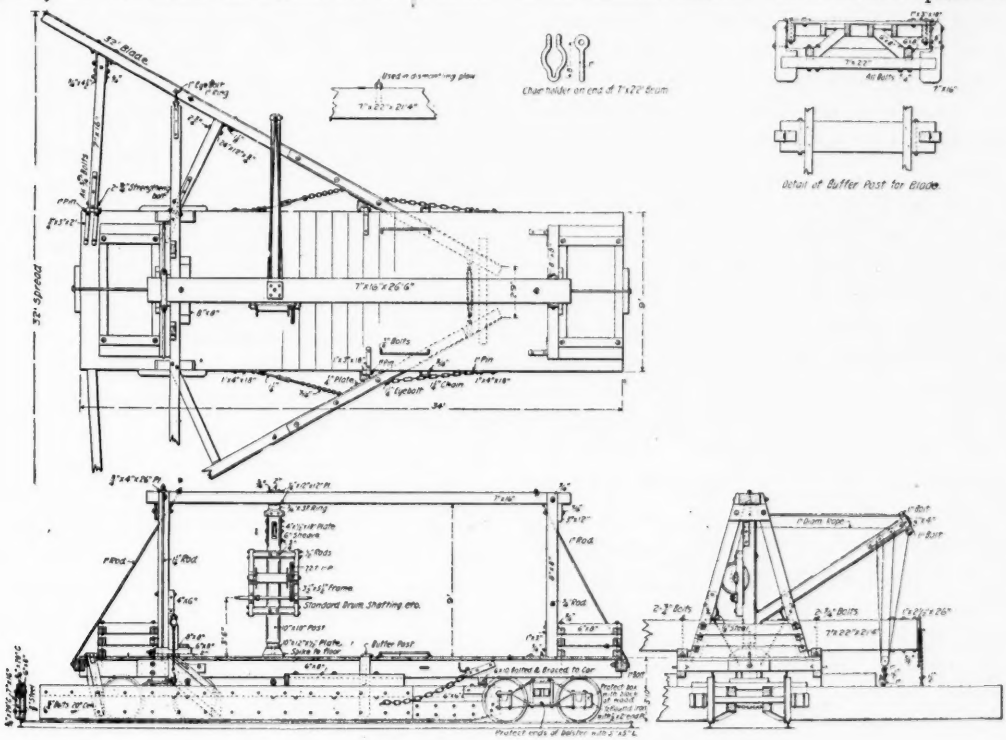


Screw-spike screwed in the Lining | Lining in place | Setting into place of the Lining by means of the driver (3rd operation) | Tapping of the hole (2nd operation) | Boring of the hole with an auger (1st operation)

Earth Spreader Car, A. T. & S. F. Ry.

THE use of spreader cars for plowing out filling material which has been dumped at the side of tracks is now very extensive, having been adopted by a large number of roads during the past five or six years; in fact, such cars are now almost indispensable to rapid and economic handling of earthwork for bank widening and filling for additional tracks. We show here the plans of a car in use at the San Francisco terminal of the Atchison, Topeka & Santa Fe Ry., particularly in what is known as the China basin improvement. The plow part of the machine consists of two timber wings 7 in. wide and 24 in. high, faced with a ⅜-in. steel plate. These are suspended underneath a flat car at a height to scrape top of rail. The wings are 32 ft. long and they can be set to spread material 16 ft. from the center of the track. They are backed up by two struts consisting of 7x16-in. timbers hinged at the edge of the car floor. The rear of the wings is supported by chains of adjustable length hanging from the ends of a 7x22-in. beam placed crosswise the car near the rear end. The forward end of the wing is suspended upon a post hinged at the top of the side sill of the car.

The wings are let down to the spreading position, and folded again for transportation by a crane, the mast of which is secured to a longitudinal beam 7x16 in., laid flat and supported upon the tops of two A-frames erected over the car trucks and securely stayed to the car. These machines are simple in construction and heavily built, and their operation has been giving satisfaction. The accompanying illustrations show numerous details which it is not necessary to describe at length, among which, however, may be mentioned the ballast boxes at either end of the car, for weighting the machine down to its work, the wooden block protection for the journal boxes, and the stay chains which take the end thrust on the spreader wings.



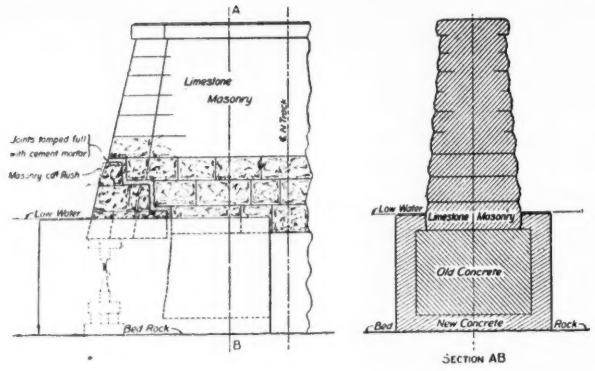
EARTH SPREADER CAR—A., T. & S. FE RY.

Reparing a Bridge Pier Foundation on the Burlington

THE illustration shown herewith refers to an interesting bit of repair work to one of the bridge pier foundations of the Burlington. This work was done by the bridge department during the last winter. The bridge is on the main line across the Des Moines river, about four miles west of Ottumwa, Iowa. Originally built as a single-track bridge, it was converted into a double-track structure by lengthening the piers and putting in double-track spans in 1899 and 1900.

The natural foundation is laminated limestone, the crevices of which are filled with earth and sand. The stone is overlaid with about 4 ft. of sand and silt. At each pier large quantities of riprap had been put in. This increased the difficulty of extending one of the piers considerably, as it was almost impossible to keep the cofferdam tight, and the contractors failed to attain the best results in placing the concrete for the foundation. About two years after completion the lower course showed a settlement about 6 ft. back from the up-stream end, or new part. In the winter of 1903-04 an attempt was made to repair it, but failed on account of a sudden rise in the river breaking up the heavy ice and carrying away the entire cofferdam.

No further attempt was made until the following winter (1904-05), as the river is subject to sudden floods in the summer season. The restricted space for working



REPAIRING A BRIDGE PIER FOUNDATION ON THE C., B. & Q.

under the bridge limited the height of the cofferdam so that its top was about 2 ft. above low water. A rise of that amount would therefore have been disastrous. In the second attempt a cofferdam of Friestedt interlocking channel bars was driven entirely around the pier about 3 ft. out from it except at the up-stream end, where a space of 8 ft. was provided for the pumps. Some of the riprap and loose stone from the old single-track pier, part of which was torn down at the time the extension was made, was raked out of the way and some was hoisted to the surface, a diver being used to attach the grappling hooks. A good deal, however, was covered with sand and gravel and could not be removed, causing some difficulty in driving the sheet piling through it. All piles, however, reached to within 6 in. of bed-rock. The water was about 10 ft. deep.

During the winter the water of the Des Moines river is very clear, carrying practically no sediment, and it was found that it leaked through the joints of the cofferdam so rapidly that it was impossible to keep it pumped out of the pit. A dam of sand, earth and manure was therefore placed entirely around the outside of the cofferdam, after which no difficulty was experienced in keeping the pit dry.

The old concrete was found to have broken away at the bottom, leaving a space of from 6 in. to 1 ft. between it and bed-rock, the space being filled with mud. It had settled down at the outer end, carrying down a section of the masonry, as shown in the accompanying sketch. The broken part of the concrete was removed, the broken section of masonry being held up by screw jacks. A number of old cast-iron jacks were used for the purpose and were left imbedded in the concrete. As soon as a section of about 4 ft. had been removed the space was filled with new concrete. The mud and sand below the concrete footing and back of the point of the pier was then removed, a short section at a time, and the space tamped full of concrete, working first on one side of the pier and then on the other. The concrete at the nose was brought up about half-way to the top of the lowest footing course of masonry.

We are indebted to Mr. C. H. Cartlidge, Bridge Engineer, for the above information.

Personals

Mr. M. J. Butler has resigned as assistant chief engineer of the Transcontinental Railway Commission of Canada.

Mr. W. C. Swartout has been appointed division engineer of the Joplin division of the Missouri Pacific at Nevada, Mo.

Mr. Henry Rohner has been appointed chief engineer of the Arkansas Southern, with headquarters at Ruston, La.

Mr. J. L. Campbell has been appointed engineer of maintenance of way of the El Paso & Southwestern and the El Paso & Northeastern.

Mr. D. C. Fenstermaker has been appointed chief engineer of the Louisiana Railway & Navigation Company.

William Huskinson, formerly for thirty-four years roadmaster of the Chicago & Alton, died on June 17, at Alton, Ill., aged seventy-eight years.

Mr. H. E. Wagner has been appointed division engineer of the Illinois divison of the Missouri Pacific at Chester, Ill.

Mr. F. B. McCutcheon, chief engineer of the Gulf & Ship Island, will after June 1 also have charge of roadway, bridges and buildings, with headquarters at Gulfport, Miss.

Mr. Louis Larson has been appointed roadmaster of the Chicago, St. Paul, Minneapolis & Omaha at Mankato, Minn., to succeed Mr. C. A. Wester, resigned.

Mr. A. W. Swanitz has been appointed chief engineer and general manager of the Valdez Copper River & Yukon Railway, with office at Valdez, Alaska.

Mr. C. McKay Watts has resigned as principal assistant engineer of the Wabash Pittsburg Terminal and Mr. W. J. Coursin has resigned as assistant engineer.

Mr. James Sullivan, general foreman of bridges and buildings of the Denver & Rio Grande, has been appointed roadmaster at Cuchara Junction, Colo., in place of Mr. J. Grattan, resigned.

Mr. J. Grattan, heretofore roadmaster of the Denver & Rio Grande at Cuchara Junction, Colo., has been appointed to a similar position on the Kansas City Southern at Duquesne, Ark.

R. G. Goldsborough has been appointed supervisor of the Pennsylvania Railroad at Kittaning, Pa., River division, vice H. W. Fitzgerald, resigned.

Mr. Charles Dunham, signal engineer of the Illinois Central, has been appointed signal engineer of the Great Northern, with headquarters at St. Paul.

Mr. B. F. Deuel has been appointed assistant division engineer of the Pennsylvania division of the New York Central & Hudson River at Jersey Shore, Pa.

Mr. W. T. Schultz has been appointed general tie and timber inspector of the Missouri Pacific, with headquarters at St. Louis, Mo., vice Mr. J. O. Potts, promoted.

Mr. W. D. Hines has resigned as assistant engineer of the Southern Railway at Washington, D. C., to become superintendent of construction for Wyatt & Nolting, of Baltimore, Md.

Mr. C. H. Ewing, division engineer of the Philadelphia & Reading at Reading, Pa., has been appointed engineer of maintenance of way of that road, a new office.

Mr. M. J. Nelligan, roadmaster of the Denver, Northwestern & Pacific, has been appointed roadmaster of the Denver & Rio Grande at Denver, Colo.

Mr. H. A. Haskell, has been appointed roadmaster of the Toledo Railway & Terminal Company and Mr. Hugh Hall has been appointed industrial agent.

M. W. B. McLaughlin, heretofore roadmaster of the St. Louis division of the Illinois Central at Carbondale, Ill., has been appointed division engineer on the Missouri Pacific.

Mr. F. G. Jonah, formerly chief engineer of the St. Louis Brownsville & Mexico, has been appointed terminal engineer of the New Orleans Terminal Company, with office at 1561 St. Louis street, New Orleans, La.

Mr. J. J. Harris has been appointed chief engineer of the Pacific & Idaho Northern, with headquarters at Weiser, Idaho. Heretofore Mr. Harris has been connected with the engineering department of the Denver & Rio Grande.

Mr. William M. Torrance has resigned as assistant engineer of the New York Central & Hudson River, to become connected with the Underwriters' Engineering & Construction Company as assistant engineer, with office at 34 West Twenty-sixth Street, New York.

Mr. R. D. Starbuck, division engineer of the Western division of the Michigan Central, has been appointed assistant chief engineer. Mr. George H. Harris, division engineer of the Ostemo division, has been transferred to the Western division at Niles, Mich., in place of Mr. Starbuck.

Mr. I. F. White, heretofore engineer of maintenance of way of the Cincinnati, Hamilton & Dayton, has been appointed superintendent of the Northern and Southern divisions, with headquarters at Dayton, O., to succeed Mr. R. H. Bowron, promoted.

The office of J. E. Murphy, engineer of maintenance of way of the Chicago, Burlington & Quincy, has been moved from Galesburg, Ill., to Chicago.

Mr. George R. Wadsworth has resigned as resident engineer on the New York Central & Hudson River to accept a position on the staff of J. G. White & Co. as assistant to the construction superintendent.

Mr. R. Kendridan has been appointed roadmaster of the Fort Worth & Rio Grande at Fort Worth, Tex., in charge of the line between Carrolltown and Sherman, succeeding Mr. T. Troy, who has been appointed roadmaster of the lines from North Fort Worth to Brady.

Mr. W. A. D. Short, superintendent of signals of the Queen & Crescent, with headquarters at Lexington, Ky., has been appointed signal engineer of the Illinois Central, with headquarters at Chicago, to succeed Mr. Charles Dunham, resigned.

Mr. J. W. Eber, recently appointed assistant to the engineer of maintenance of way of the New York Central at New York, has been given the title of engineer of tracks.

Mr. Patrick Sloan, roadmaster of the Denver & Rio Grande at Palmer Lake, Colo., has been appointed roadmaster of the Kansas City Southern at Spiral, I. T. Mr. W. C. Ferguson, heretofore chief clerk to the general superintendent of the Denver & Rio Grande, has been appointed private secretary to General Manager Coughlin of the Kansas City Southern.

Mr. W. S. Kinnear, assistant general manager and chief engineer of the Michigan Central, has resigned as chief engineer, to devote his time to the construction of the tunnel under the Detroit river at Detroit, Mich., and Mr. George H. Webb, assistant chief engineer, has been appointed chief engineer, with headquarters at Detroit.

Mr. C. M. Buck, assistant engineer of the Atchison, Topeka & Santa Fe at Marceline, Mo., has been appointed office engineer of that road, succeeding Mr. G. W. Smyser, resigned. Mr. H. W. Wagner, assistant engineer at Arkansas City, Kan., has been appointed assistant engineer at Marceline, Mo., to succeed Mr. Buck. Mr. W. S. Hughes has been appointed assistant engineer at Arkansas City, Kan., to succeed Mr. Wagner.

Mr. Schuyler Hazard, roadway engineer of the Southern Railway at Birmingham, Ala., has been appointed resident engineer of the New York Contracting Company, with headquarters at Westchester, Borough of the Bronx, New York City. He will have charge of six-tracking the Harlem division of the New York, New Haven & Hartford from One Hundred and Twenty-ninth street, New York City, to New Rochelle, N. Y.

Mr. Alan D'Heur, resident engineer of the Southern Pacific at Bakersfield, Cal., has been appointed district engineer of maintenance of way of that road, with headquarters at Los Angeles, Cal. Mr. W. C. Eads, has been appointed district engineer of maintenance of way of the Southern Pacific, with headquarters at San Francisco. Mr. H. B. Titcomb, assistant resident engineer of the Southern Pacific at Bakersfield, Cal., succeeding Mr. D'Heur.

Mr. R. K. Rochester, heretofore division engineer maintenance of way of the Vandalia Railroad, has been appointed principal assistant engineer, with headquarters at Saint Louis, Mo. Mr. E. L. Shaneberger has been appointed engineer maintenance of way of the Michigan division at Logansport, Ind., to succeed Mr. Rochester. Mr. H. C. Johnson, heretofore engineer maintenance of way of the Peoria division at Terre Haute, in place of Mr. Shaneberger.

Effective on May 15, Mr. F. Neher is appointed prin-

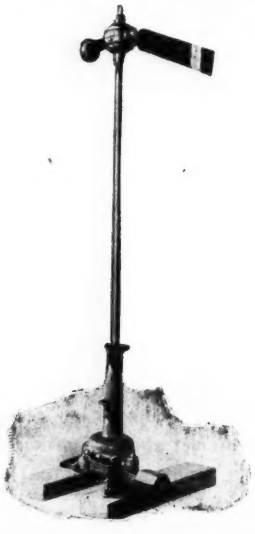
cipal assistant engineer of the Missouri Pacific and the St. Louis Iron Mountain & Southern, with headquarters at St. Louis, Mo. He will have supervision over surveys and new work other than bridge building and signal work. Where such work is executed by the division authorities, the instructions of the principal assistant engineer will govern the methods to be employed. He will report to the engineer maintenance of way.

Mr. J. W. De Moyer has been appointed division engineer of the Shamokin division of the Philadelphia & Reading at Tamaqua, Pa., to succeed Mr. F. McQ. Falck, who has been transferred to Reading, Pa., as division engineer of the Reading and Lebanon divisions, in place of Mr. C. H. Ewing, who has been appointed engineer maintenance of way. Mr. W. D. Kinzie, supervisor at Bridgeport, Pa., has been transferred to Pottsville, Pa., in place of Mr. De Moyer. Mr. C. H. Stein has been appointed supervisor at Bridgeport. Mr. R. Boone Abbott, heretofore assistant supervisor at Tamaqua, Pa., has been appointed supervisor at East Penn Junction, in charge of the East Penn branch, C. & F. branch, and the Perkiomen Railroad. Mr. H. H. Barr, supervisor at Reading, Pa., will hereafter have charge of the territory from Reading to Tamaqua.

Mr. J. G. Taylor, heretofore division engineer of the Western division of the St. Louis & San Francisco, has been appointed division engineer of the Eastern, Central and Southwestern divisions, with headquarters at Springfield, Mo. Mr. C. B. Spencer, heretofore division engineer of the Northern division, has been transferred to Joplin, Mo., in charge of the Northern and Western divisions. Mr. N. B. Hanna has been appointed division engineer of the Southern division and the Kansas City, Memphis & Birmingham, with office at Memphis, Tenn. Mr. H. P. Hall has been appointed assistant division engineer of the River and Cape division at Cape Girardeau, Mo.

Semaphore Switch Stand

With the unification of signal standards in view, the semaphore switch stand has met with favor on some roads. A main line stand of this type is shown herewith, it being of the ground throw style operated by hand, carrying blade and revolving lamp. The same stand is also made with stationary lamp and spectacles where that form is preferred. The makers claim many advantages for the semaphore stand, pointing out particularly the fact that it shows the position of the switch points more positively from a distance than the color and shape styles.



SEMAPHORE SWITCH STAND.

Differing from the target stands, the positions of which seem to interpret themselves in various manners to various minds, the semaphore appears to have a universal language which appeals alike to all and points out in a simple but natural way the conditions of safety or danger by the mere suggestiveness of its position. In the glare of a headlight the blade is easily seen from a distance at which a target could not be observed with any certainty, if at all; and in the case of dim or extinguished lamps an element of safety is added which should augment its employment.

The illustration is one furnished by the Buda Foundry & Manufacturing Company, Chicago, who make a large variety of switch stands of the semaphore type and also of the target styles.

Waterproofing the Pennsylvania Tunnels at New York

The problem of waterproofing concrete lined tunnels is of such importance that the following revised specifications for the Pennsylvania R. R. tunnel work in New York City will be of interest.

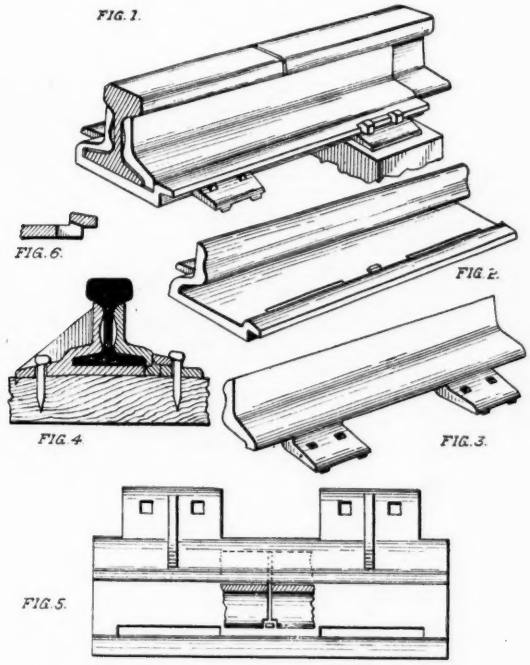
(297) The space less thickness of waterproofing between the sides of the excavation and the neat lines shall be filled with concrete behind suitable forms. After the forms are removed the surface of the concrete shall be given a ½-in. coat of mortar containing equal parts by volume of Portland cement and sand and troweled smooth. After the mortar has set and dried out, it shall be covered with alternate layers of coal-tar pitch and felt, seven layers of pitch and six of felt. The felt shall be "Hydrex" felt, manufactured by F. W. Bird & Son, of East Walpole, Mass., or felt equally satisfactory to the engineer. The pitch shall be straight run coat-tar pitch which will soften at 60 degrees Fahrenheit, being a grade in which distillate oils, distilled therefrom, shall have a specific gravity of 1.105. The pitch shall be mopped on the surface of the concrete to a uniform thickness of not less than 1-16 in. Immediately on this coat of pitch, and while it is still melted, there shall be laid a covering of felt, the sheets to lap not less than 12 ins. on both transverse and longitudinal joints, and to be made to adhere firmly to the pitch covered surface of the concrete everywhere. This felt layer shall be mopped with pitch as above specified, another layer of felt then added and mopped with pitch, and the process continued to the full number of layers required. The waterpoofing shall extend from the level of the bottom of the electric ducts to a point about 22 deg. 30 min. above the spring line of the roof arch. After the waterproofing has been placed the remainder of the concrete with the electric ducts, etc., shall be placed.

(298) The roofs of tunnels shall be covered with two triple layers of felt and seven layers of pitch, each of the quality specified in the preceding paragraph, except that the layer of pitch laid directly on the brick, the layer between the third and fourth layers of felt and the outer layer shall soften at about 32 deg. F., and melt at about 60 deg. F., so that it can be spread without heating. A layer of this shall be spread on the brick and covered with a layer made up of three thicknesses of felt interlaid with pitch of the quality described in the preceding paragraph. On this triple layer shall be spread another layer of soft pitch followed by another triple layer of felt and the whole covered with a third layer of soft pitch,

the whole constituting seven layers of pitch and six thicknesses of felt. On the longitudinal joints the triple layers shall lap at least 2 ins. of triple thickness, making 10 ins., including the single and double thicknesses, and on the cross joints the lap shall be 6 ins. greater. The waterproofing courses above described shall be covered with one course of brick laid flat in a ½-in. bed of mortar containing equal parts by volume of cement and sand and the joints completely filled with mortar of the same composition. The junction between the waterproofing in the roof and sides shall be formed so as to make a continuous waterproofing. The right is reserved to the engineer to substitute for the waterprofing above described any other which in his judgment will be more satisfactory or advantageous to the company, and he will fix the unit prices therefor. In such unit prices the contractor shall be entitled to the allowance for contingencies and profit as exist in his price for the waterproofing above specified.

A New Boltless Rail Joint Splice

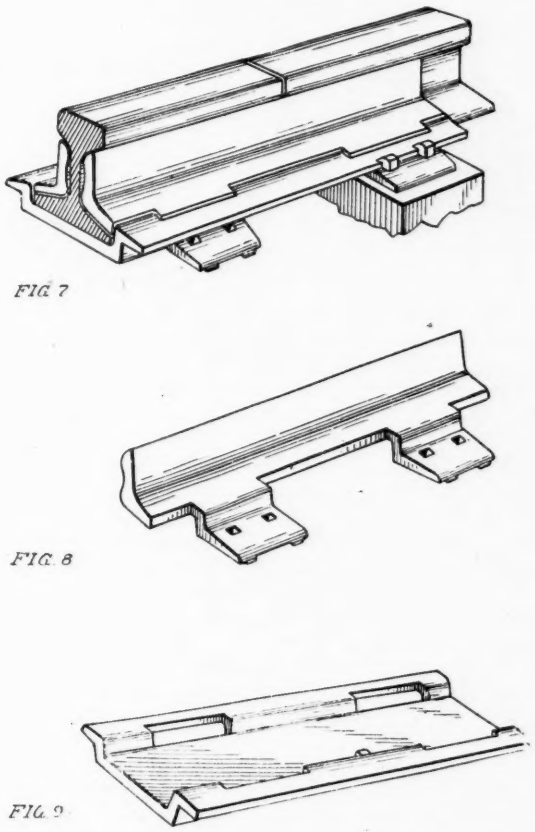
In the accompanying illustrations we show a new boltless rail joint splice which has been recently designed by Mr. Newton J. Vosler. There are two patterns, one consisting of two pieces and the other of three pieces. The two-piece splice is shown in Figs. 1 to 6, inclusive. This is made of malleable iron, consisting of a base plate and angle bar combined, with an interlocking angle bar for the other side of the rail. The interlocking is effected by means of slots through the base piece, and tail pieces, or lugs, on the separate angle bar. After the parts have been locked together the base plate is spiked to the joint ties. It is impossible for the parts to become separated, even before the spiking is done, as, in order to take the joint splice apart the rail must be lifted ½ inch.



TWO PIECE BOLTLESS JOINT SPLICE.

The three-piece joint is shown in Figs. 7 to 9, inclusive. It is similar to the other arrangement, with the exception that two separate and duplicate angle bars are used in place of one, being interlocked with the grooved base plate, and all the parts may be of rolled sections. With either pattern of splice the rails are prevented from showing or creeping through it by a stud in the base plate.

The manner of the interlocking parts acts to clamp the bars harder to the rail as the load comes on the joint, or the reverse effect of loading any of the ordinary joint splices which tend to work apart or away from the rail when the downward pressure comes on. It is this effect with ordinary joint splices which makes joint bolts necessary. The simplicity of the design is so apparent from the illustrations that further description is hardly necessary.



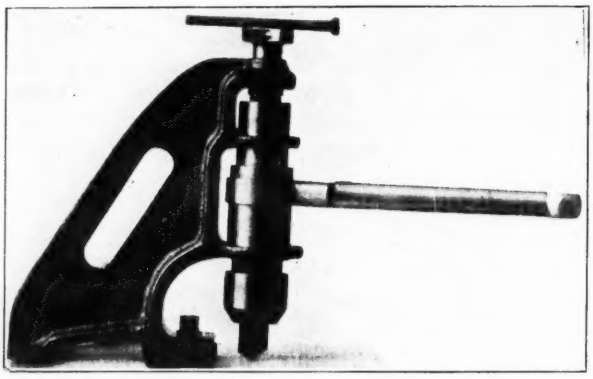
THREE PIECE BOLTLESS RAIL JOINT SPLICE.

These new joint splices are being promoted by the Boltless Rail Joint Company, of which Mr H. C. Hope, superintendent of telegraph of the Chicago, St. Paul, Minneapolis & Omaha Ry., is vice-president.

The Rich Track Drill

The need of a track drill that combined simplicity in its details, one that was easily portable, and that could be set at work in the fewest moves, besides always be out of the way of passing trains when set up in position at the track, has been met by the new tool brought out by the Geo. B. Rich Mfg. Co., Buchanan, Mich. This efficient little device forms a unit with its malleable iron frame, into which the ratchet is secured as a permanent fixture. The illustration shows the drill in a vertical position, in order to make it as clear as possible to the observer. If the picture is conceived to be in a horizontal plane, then the tool will be seen as from above when in operation at the track.

On the frame near the drill point, there is a pair of hardened steel jaws (one of which is seen) which are made to expand by an eccentric which bears against the jaws, forcing them out against the rail head and flange. Each jaw has raised points on its bearing surface, which are forced into the rail with a pressure of about 60,000 lbs., and penetrates



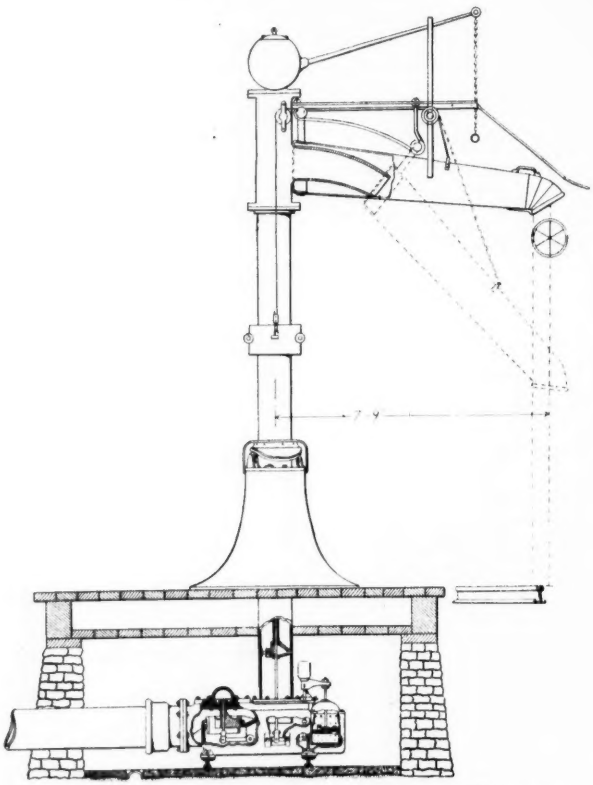
RICH TRACK DRILL.

steel as high as 0.60 carbon, holding the drill against the coarsest feed man power can exert with the ratchet.

A ball bearing thrust makes the drill, which is of high speed steel, work against very litle friction. These drills are used on high carbon rails about three months with one grinding. The feed is automatic and adjustable, and the handle is detachable and is secured to the frame when not in use, by bearings provided for it. The whole thing weighs only nineteen pounds and is easily carried by the handhold cored in the rib of the frame. Appliances for track maintenance are usually associated with the idea that any thing to do that work must necessarily be of a crude order, but this tool would be entitled to a high place among the best for any class of work.

The Improved Poage Automatic Water Column

Our illustration of the improved Poage water column made by the American Valve & Meter Co., Cincinnati, O., represents an improved construction in the spout arrangement that places the column in the front rank with locomotive watering appliances. The spout has a vertical adjustment of five feet when the column is placed seven feet nine inches from the center of the track, and a greater movement proportional to the increase in length of the spout. This vertical movement is an ingenious conception, giving a parallel motion to the spout opening, through its whole range of action. The philosophy of this is apparent when it is said that the spout operates with equal efficiency, no matter what the size of manhole or the height of tank. The spout is in perfect balance, and is moved with ease either vertically or horizontally. These results are attained by the simplest construction, the outer end of spout being supported by the cable passing over rollers and attached to a counterweight, while the inner end is supported by a roller running on a track above the T-nozzle, all of which the illustration makes clear.



THE IMPROVED POAGE AUTOMATIC WATER COLUMN.

The Homestead Steel Tie and Rail Coupler

The Homestead steel tie shown in our illustration is one of the latest developments of the all-steel rail fastening. The tie is of I-section, made of rolled or pressed steel plate with a wide flange at the bottom and a narrower one at the top for the rail to rest upon. The rail is held to gage by the combined tie anchor and rail chair at the end of the tie, the anchor forming an angle, the short end of which rests upon and bears against the end of the chair, which in turn fits between the flange and head of the rail, while the long end of the anchor is let into the end of the tie and passess down into the ballast. Two bolts pass through the inside chair, which is let into the upper flange of the tie, and the long leg of the anchor making a secure fastening. An efficient nut lock is formed by a swivelling strip of metal (not shown) which passes between the nuts and prevents backing off. This device is owned by the Homestead Valve Co., Homestead, Pa.

THE HOMESTEAD STEEL TIE AND RAIL COUPLER.

Duff Roller Bearing Screw Jacks

The Duff Manufacturing Company, Pittsburg, Pa., have placed on the market a new and complete line of roller bearing screw jacks offering twenty-five or more different sizes and have other sizes and designs in course of construction. These jacks have been constructed after a long period of careful designing and have been put to abnormal tests in order to prove their superiority over any style of jack ever placed on the market for heavy work. These tests have demonstrated that this new type of jack will involve a large

saving in operating expenses and in time and labor as well, and it further developed that heavier loads could be lifted easier and with less wear than with any other jack of the anti-friction bearing type. It was demonstrated that the same load could be raised about 15 per cent easier with this jack than with other anti-friction screw jacks.

The design and construction are important features and it will be seen from the sectional cut herewith reproduced that it contains two roller bearings—one large or main bearing at the head, and another to take the thrust on the bevel pinion. This additional bearing is a valuable feature and is found only in the "Duff" jacks.

The main feature of any anti-friction jack, however, is the bearing itself. The roller bearing used is a patented bearing of special construction and one that is particularly valuable when applied to lifting jacks. It consists of two hardened ground tool steel plates with a cage between them carrying the hardened ground rolls. A cut of the two bearings employed is shown herewith. This form of bearing is the most durable, most reliable and the most economical that has ever been used in connection with lifting jacks.

It will stand heavier loads, is more simple and will wear better than ball-bearings, or any other form of roller-bearings, and the rolls will not crush or flatten and will not wear grooves in the hardened plates after continuous service, as is often found in anti-friction bearings. When the bearings are removed from the jack frame, they remain intact and do not separate and become hard to handle.

The ratchet is also of special construction and is simpler, more convenient and more reliable than the old style of ratchet, still used on many kinds of screw jacks. With the "Duff" ratchet the jack may be reversed easily and quickly, this operation being so simple that even the most unintelligent operator is able to understand the entire working at a glance.

These jacks cover a wide and an important field in the handling of railway equipment, in bridge work and in the way of wrecking purposes. They are manufactured in all sizes with capacities from 15 to 70 tons, and the Duff Manufacturing Co. are also making cone bearing and roller bearing journal jacks with capacity of 10, 15 and 25 tons.

Some features of these jacks are already patented and the "Duff" Company have other patents applied for, which will cover all features. They have already proven themselves superior to hydraulic or other types of anti-friction screw jacks. They are reliable, always ready for service, much cheaper in first cost and in cost of operation, and will give better and longer service than other jacks for heavy lifting.

The Duff Manufacturing Company have a reputation for their high standard of excellence in materials and workmanship and the "Barrett Jacks," manufactured exclusively by them, have been the world's standard for years for railway track and car work. The high standard of the Barrett jacks will be maintained in their new line of roller bearing screw jacks, which are displacing the unreliable hydraulic and other forms of anti-friction jacks which are expensive to maintain.

The Duff Manufacturing Company are the largest manufacturers of jacks in the world, and their works at Allegheny, Pa., have been greatly enlarged recently to accommodate the increased number of sizes of Barrett jacks and the special department devoted to the manufacture of roller bearing screw jacks. The engineering department is continually experimenting with new ideas and possibilities in the line, as well as improving and constantly adding to their already large line.

Truly, the motto of the Duff Company appears to be fulfilled—"Give me where I may stand and I will move the world." Certainly their product is known and is being used in nearly every corner of the world that boasts of even a semblance of a railroad.

Water Purification for Locomotives

The report of the committee of the Maintenance of Way Association on water purification as outlined presented three problems:

First.—Water softening methods and plans for various conditions.

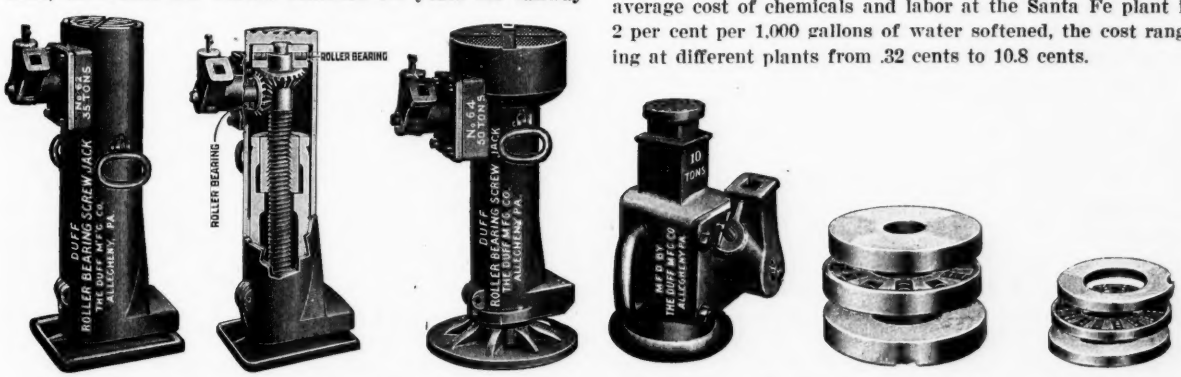
Second.—Comparisons of the cost of installing and operating water softening plants; the benefits derived from their use.

Third.—The general conditions under which the installation of water softening plants would produce savings.

Although water softening by American railroads is in its infancy, yet the results obtained fully warrant the efforts that have been made, and the fact that more and more plants are being built every year by American railroads indicates that they realize the possibilities for saving, and they are not neglecting them.

The five American railroads that have gone into the matter most extensively in the West, where the water supplies are much worse than in the East, are the Santa Fe, the Northwestern, the Rock Island, the Southern Pacific and the Union Pacific, and in the East the most prominent roads using purifiers are the Pittsburg & Lake Erie, the B. & O., and the Vandalia.

On the Santa Fe Road the water softening plants are located in western Kansas and Colorado. As a result of a comparison between 1902 and 1904 the locomotive failures from leaks have decreased 74 per cent since the softening not materially increased. The life of flues has been increased, so that a new set of flues lasts from 12 to 15 months; whereas before the water was treated they had to be renewed in from six to eight months. The number of new tubes issued by the Stores Department has decreased nearly 100,000 lineal feet. The cost of boiler repairs has also been reduced. The average cost of chemicals and labor at the Santa Fe plant is 2 per cent per 1,000 gallons of water softened, the cost ranging at different plants from .32 cents to 10.8 cents.



DUFF ROLLER BEARING AND CAR INSPECTOR'S JACKS.

On the Chicago & Northwestern water softening plants are located in Iowa, Minnesota and Illinois. On the lines between the Mississippi and Missouri rivers, 352 miles, they have equipped 17 water softening plants. All locomotives running on this division are supplied with soft water, the other plants having a supply of natural soft water. After a year's service the cost of wages for boiler makers has been reduced 25.8 per cent, and the number of engine failures has dropped to a remarkable degree. The total failures due to leaky tubes, leaky fireboxes and leaky arch tubes, August, 1902, to June, 1903, was 583, and August, 1903, to June, 1904, only 120, showing a reduction of 79 per cent in boiler failures, with a greater mileage of engines. During the period the decrease in the amount of coal consumed per 100 train-miles was 4 per cent. The average cost of chemicals on the Northwestern is 1.8 per cent per 1,000 gallons, the cost ranging from .8 to 3.4 cents.

On the Chicago, Rock Island & Pacific Railway there are 15 water softening plants on the Kansas division, only a few of which have been operating more than six months, and they have not had time to collect statistics and data relating to them.

On the Southern Pacific the water softening plants are located in California. Some of them have been operating since 1896, and they now have ten new plants in course of construction. Their records show that during the last eight years the cost of boiler repairs has been decreased 50 per cent by the use of softened water. The average cost of chemicals was 4.4 cents per thousand gallons, ranging from 1.4 to 7 cents.

On the Union Pacific Railroad the water softening plants are located in Nebraska, Wyoming and Kansas. As a result of their use the average life of a set of tubes in locomotives has been increased from six months before water was softened to two and one-half years after. In freight service the life has been increased from one year before using softened water to two and one-half years with it. The gross tons per pound of coal has been increased 7½ per cent and the cost of repairing of locomotives monthly decreased 34 per cent as a result of the use of water softening plant. The average cost of chemicals on the Union Pacific is 1.3 cents per thousand gallons.

The committee summarizes the benefits from the water softening plant as follows:

Fewer boiler failures due to leaks; longer life of tubes and firebox sheets; reduced cost of labor for repairing and washing boilers; increased locomotive mileage between shoppings; increased ton-mile per pound of coal; decreased number of locomotives in service; shorter time required for locomotives to go over the road; less expense in cost of overtime and delay.

In regard to the necessity for water softening plants caused by the large locomotive, the committee says the large locomotive necessitates larger boilers and fireboxes and the use of an increased amount of water and fuel to furnish steam to operate them. The larger the amount of steam required the more water must be evaporated to produce it. During the generation of steam the solid impurities, such as the different salts of lime, magnesia, etc., that were dissolved in the water remain in the boiler and form scale; the more water evaporated, therefore, the greater the deposit of scale. It is for this reason that the quality of water used in boilers has become so important a question within the last few years. With locomotives hauling maximum tonnage and often 15 to 20 hours on the road the effect of bad water is more apparent, and the necessity of doing something to relieve this trouble becomes imperative. While the use of soda ash in an engine tank was fairly satisfactory for small locomotives doing limited service, with the larger locomotives it is found necessary to resort to some process of treatment by which the incrusting matter can be removed from hard water before it is allowed to enter the boiler. In general it may be said that if the water is corrosive it should be treated to remove the cause of corrosion. If it contains 15 grains per gallon of hardening solid matter in solution it will pay to soften it, no matter what this scale forming material consists of. If the water contains less than 15 grains per gallon of incrustation solids, consisting of sulphate of lime, it will pay to soften it. If it contains 50 grains per gallon of alkali salts and a large quantity of sulphate of lime and magnesia it will not pay to soften it, as the resulting softened water would doubtless cause foaming.

Mr. H. Stillman, engineer of tests of the Southern Pacific, says: "I have long taken the stand that the matter of water treatment can be overdone and that waters for locomotive boiler use cannot be properly treated when the total alkalies naturally contain and resultant exceed 30 grains per gallon. Railroad managers must learn to discriminate between what can be done and what cannot be done in the way of water treatment as well as the other items of their service. Better railroading can be done in the way of getting locomotives over roads with their trains with a hard rather than with a soft water where soluble alkalies are present in excess in either water. There is no reason why we should not do what we can and where we can in the way of chemical treatment of waters for locomotive use."

Dearborn Laboratories

The Dearborn Drug & Chemical Works of New York and Chicago, make a specialty of the treatment of boiler feed waters. This company have for the past 15 years been handling the water proposition in stationary plants for the prevention of scale and other troubles caused by feed waters in boilers, so that Dearborn feed water treatment prepared to suit the case has been universally adopted by the operators of stationary boilers all over the country.

This company have established offices in 20 of our principal cities in the United States, one in Havana and one in Honolulu, H. I.

About two years ago the company established their railroad department. The ability of the Dearborn Company to successfully handle the alkali waters of the West, containing, as they do, large quantities of sodium sulphate, carbonate and chloride, which cause great trouble with locomotives foaming and soon destroy the tubes on account of corrosion, pitting, etc., has been a great relief to railway operators. It is, of course, impossible by any method of precipitation to remove this alkali salts so that they must be treated in the boiler, and the Dearborn Company are making preparations, composed of organic extracts and wood fiber starches, properly proportioned, which when used in small quantities in the locomotive is claimed absolutely to prevent foaming and all corrosive action of these salts, so that engines using such treatment are able to do away with blowing off almost entirely, and the distance made between washouts is doubled and in some cases three or four times the milage can be successfully made without washout than was possible without the use of such treatment, while the life of the boiler tubes is greatly increased.

The Dearborn Company have been so successful in handling waters of this class that most of the larger systems west of the Missouri river have adopted the use of the preparations made by this company on their alkali districts, and such preparations also handle and prevent the formation of a limited amout of scale.

The general office and laboratories of the company are located in Chicago. Their equipment for testing work of all kinds is, perhaps, the most complete of any commercial

laboratory in this country, and their policy of preparing special preparations to suit the analyses of waters has been the scientific basis upon which their successful results have been attained both on stationary, marine and locomotive work.

The officers of the company are: Wm. H. Edgar, president; Robert F. Carr, first vice-president and general manager; Wm. B. McVicker, second vice-president and Eastern manager; C. M. Eddy, secretary and treasurer; Robert W. Francis, directing engineer; Wm. A. Converse, directing chemist.

Notes of the Month

It is stated that the Pittsburg, Bessemer & Lake Erie R. R. has ordered 2,100 tons of steel ties, enough for ten miles of track. This road is controlled by the United States Steel Corporation, and the plan is undoubtedly to demonstrate the value of steel ties in comparison with wooden ones.

The Buda Foundry & Manufacturing Company, Chicago, are shipping 98 push cars to Panama, this being partial shipment of a large order for various track construction supplies received by them a few days ago. This company has been particularly fortunate thus far, in receiving orders from that territory.

It has been announced that the Chicago freight subways will be opened for traffic during the last of August. There are now 32 miles of tunnel and construction work is progressing rapidly, 6,000 tons of excavated material and building material being handled every day. During the past two months 60,000 cu. yds. of material have been excavated and 25,000 cu. yds. of concrete lining has been placed.

There was launched on May 4 at Nagasaki, by the Mitsu Bishi Dockyard and Engine Works, for use at their repairing yard which they are establishing at Kobe, a steel floating dock of the following dimensions: Length, 387 feet 6½ inches; length over all, 412 feet 6½ inches; breadth, 85 feet ½ inch; depth, 41 feet 7¼ inches; lifting power, 7,000 tons. This dock will accommodate the largest of the merchant vessels owned in Japan.

Orders have been issued by the division superintendents of the Pennsylvania R. R. to their engineers to take care that they do not let their locomotives stand directly under signal bridges, as the smoke, steam and cinders may cause considerable damage to the signal apparatus. This order is said to have been issued at the request of the signal engineering department.

The past year has shown a considerable increase in the traffic handled through the Suez canal, and the directors will vote a dividend of 141 francs per share. The net tonnage for the past year was an increase of 1,494,547 tons, as compared with that of 1903, and of 2,153,422 tons, as compared with that of 1902. Notwithstanding the reduction of 50 centimes in the tonnage dues, which took effect from the 1st of January, 1903, the transit receipts during that year amounted to 103,620,288 francs, or only 99,752 francs less than those of 1902, while those for the last year amounted to 115,318,479 francs, and were higher than in any previous year since the opening of the canal. The increase in the tonnage during 1904 was owing to heavy shipments of wheat from India to Europe, and to the large quantities of coal consigned to the east, which latter exceeded about 500,000 tons the shipments during the year 1903, and which were largely for the use of belligerent fleets. The number of vessels which passed through the canal was 3,708 in 1902, 3,761 in 1903 and 4,237 in 1904.

The Chicago drainage canal board, at a meeting this week, determined upon the immediate purchase of the right of way for the proposed Calumet and Evanston auxiliary channels, which with their completion will add another additional $15,000,000 to the cost of the great sewage canal. The action was taken upon the request of committees representing the citizens of the district affected. In all there will be fourteen railroads intersected, and it will be necessary for the drainage board to secure a right of way across them, as well as a right of way from nearly 700 property holders along the 25 miles of the two channels. The Calumet channel will be 16 miles long, 15 feet wide and 22 feet deep, and will carry 225,000 cubic feet per minute. When completed it will cost $12,000,000. The Evanston channel will be nine miles long, 80 feet wide, and 12 feet deep, with a capacity of 60,000 cubic feet per minute. It will cost $3,000,000. The right of way for the Clumet canal will cost $750,000, while for the Evanston canal it will cost $1,035,592.

The U. S. consul at Nottingham reports that the experimental use of motor omnibuses has gone to a considerable length in England, but, contrary to a previous supposition, the result apparently demonstrated the greater utility and economy of electric street railways. As respects utility, it is concluded that the electric motor driven vehicle is much simpler and possesses superior power in sundry ways in comparison with a petrol motor vehicle. But particular stress is laid on the greater cheapness of operation and maintenance of the electric railway in comparison with the motor omnibus. Experience shows, it is claimed, that the rubber tires of the omnibus cost for maintenance about 4 cents a mile against 2½ cents a mile per car for rails, allowing for the capital expenditure in the original cost. This difference is figured at not less than $500 per annum for each vehicle.

The cost of propulsion is also given as much less for the electric car. For each ton weight thereof the cost of electricity is placed at 24 cents, while for each ton weight of vehicle propelled by a petrol motor the cost of petrol is placed at 80 cents. It is further estimated that the cost of petrol is likely to rise as the demand increases, while the cost of producing electricity is steadily falling, and it is noted that the expenditure therefor would be even less than it is if street railway cars were allowed to go as fast as motor omnibuses.

A good deal of public discussion has arisen from the recent decision of the executive committee of the Panama Canal Commission to purchase supplies in the cheapest market, notwithstanding the nationality of the producer. It is understood that this policy has the endorsement of the administration. It is represented that the money consideration is so great that the plan cannot be ignored, for it is said that in most cases fully 50 per cent more would be charged for American material needed in canal construction than the same goods could be produced for in Europe. Two ships, in addition to those running between New York and Colon, and owned by the Panama Railroad Company, are necessary to carry the food supplies and material needed for the work. No American ships can be bought at any reasonable price, and when it comes to building such ships it was found, according to Secretary Taft's statement, that while he can buy two 2600 ton ships in Europe for $750,000, it would cost $1,400,000 to build such ships here. And in addition, while the European ship could be had at once, it would take at least eighteen months to secure American boats. Therefore it was decided to buy the ships in Europe, or rather in any port where they could be had cheapest and obtained the quickest. As to material needed for canal construction, the committee decided that by reserving to itself the right to purchase in the world's markets it would at least oblige American manu-

facturers to give them the benefit of their foreign prices if they wish to sell goods to the committee.

Excavation on a large scale has been started for lowering the Pittsburg, Ft. Wayne & Chicago Ry. tracks by the Pennsylvania company through Allegheny. The portion of the road to be lowered extends from under the Western avenue bridge to 700 ft. west of Washington avenue, about 1¼ miles in all. This is a four-track line, which means that five miles of running tracks alone must be put down to the new grade. Steam shovels have been started to work on some of the yard tracks through Allegheny, and the addition of these tracks will greatly increase the actual mileage of track to be lowered. This will include what is known as the Pennsylvania avenue yard, a teaming yard consisting of about 10 tracks each several hundred feet in length. Other tracks lead to the freight depot just west of the North avenue crossing. On the north side of the running tracks west of Pennsylvania avenue are the repair shops, roundhouse and a large number of tracks, and there are several tracks parallel to the running tracks used for various siding purposes. The tracks used in that portion of the yard where the repairs are made are of considerable length. New foundations will be provided for the roundhouse and shop buildings, as they are to be left on their present level, and raised approach tracks will be constructed from the new grade of the running and other tracks. The roundhouse and shops will probably be from 10 to 15 ft. above the level of the yard around them. This is an important feature of the engineering side of the improvements. As nearly 150 passenger trains and a large number of freight trains are handled over the P., Ft. W. & C. Ry. tracks out of Allegheny, it will be a matter of skillful operation on this (the Eastern) division to keep trains running without delay or confusion, while some of the tracks are out of commission and trains are using temporary tracks.

In continuation of United States Consul Ravndal's reports on the Cape to Cairo Railway, United States Vice-Consul William C. Magelsen, Beirut, Syria, transmits on April 25 the following article from a recent issue of the Gazette, published at Alexandria, Egypt:

A most important link in the line from the Cape to Cairo was formed on Saturday week when the great bridge—the highest in the world—over the gorge at the Victoria Falls on the Zambesi River was connected up. This cantilever bridge, which thus forms another link in the Cape to Cairo Railway, initiated by the late Cecil Rhodes, crosses the Zambesi for a distance of 650 feet at a height from low water level to the rails of 420 feet, or about 380 feet from high water. The second highest bridge in the world is the Viaduct du Viaur, in France, 375 feet.

The bridge was built by an English company on the girder pattern. It is constructed in three spans and has a width of 30 feet. The work was commenced simultaneously from both banks of the river, an electric motor cable with a span of 900 feet, the largest thing of its kind yet attempted, carrying the material from one side to the other. The bridge has ten bays in all, and the rate of construction was estimated at about two bays a month. The delicacy of the operations may be judged from the fact that the slightest deviation from a level would have been productive of considerable difficulties. As it is, the bottom booms have been bolted up.

The Cape to Cairo Railway is an endeavor to connect Egypt with South Africa by a line 5,700 miles long. From the north the railway has reached Khartoum, a distance (allowing for the river gap between Assuan and Wady Halfa) of 1,400 miles. In the south good progress has been made north of the Zambesi, on the section known as the northern extension, from the Victoria Falls to Kalomo, the administrative center of Barotseland, a distance of 100 miles. From Kalomo the line is to be continued for another 250 miles in a northeasterly direction. It is probable that from Tanganyika there will be two lines, one through the Kongo and another through German territory.

United States Minister W. W. Russell, Bogota, Colombia, under date of May 4, 1905, reports that the present administration has been very active in its efforts to open up the interior of the country and develop and encourage industries. A great number of concessions have been given to natives for improving existing roads and for opening up new ones.

Henry G. Granger, an American citizen, has been given a concession for building a railway from a point on the Gulf of Urba (Darien), to be called "Ciudad Reyes," to Medellin, the capital of the Department of Antioquia, with the privilege of building branches and extensions to the southern part of the Department of Cauca. The government guarantees a subvention of $30,000, or 10,000 hectares (24,685 acres) of land for every completed kilometer (0.62 mile) of the railway. This concession carries with it the privilege of utilizing all coal and petroleum deposits along the line. It is the intention of the concessionaire to clear off the valuable timber which exists in abundance along the route, and cultivate bananas, rubber, cane, and other tropical products. Ciudad Reyes is to be made an industrial city.

Minister Russell also reports that another important concession in which American capital will probably be invested has been granted to J. T. Ford, general manager of the American companies in Cartagena. This concession is for building a railway from La Dorada, the terminus of navigation on the Magdalena River, to a point north on the river about 30 miles below Puerto Berrio, to which point the river boats can always arrive without danger to navigation on account of scarcity of water. With this concession there is an optional contract for the completion of the railway from Puerto Berrio to Medellin. This railway extends at present from Puerto Berrio to Caraceli, and is to be completed from Caraceli to Medellin, a distance of 140 kilometers (86.9 miles).

The contract for the extension of the La Dorada Railway from its southern terminus, Honda, southward to Ambalema, on the upper Magdalena River, has been awarded to Pierson Brothers, English contractors. This railway is controlled by the English debenture holders.

Another concession just published is granted to Enrique Cortes, representative of European capitalists, for the construction of three divisions of railway, as follows: (1) From the Magdalena River to Bucaramanga, the capital of the Department of Santander; (2) from Bucaramanga to the frontier of the Department of Boyaca; (3) from the frontier of the Department of Boyaca to Bogota.

Technical Publications

ROCK EXCAVATION—METHODS AND COST. A practical treatise, with illustrations, by A. P. Gillette, C. E. Bound in cloth. Published by M. C. Clark, New York. Price $3.00. This treatise supplies data in the condensed form on the cost of rock excavation, together with descriptions of methods of doing the work. It is put up in such form that any inexperienced man may estimate with tolerable accuracy the cost of removing rock and at the same time points out to the manager how he can save money by studying the 'tricks of the trade employed by other engineers. The contents are on quarrying, open cut excavations, trenching, subaqueous excavation, tunneling and underground excavation.